FOOD AND FEEDING RELATIONSHIPS OF SOME COMMERCIAL FISHES OF THE TUNGABHADRA RESERVOIR

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Puntius kolus with protrusible mouth is euryphagic in feeding, subsisting on molluscs, insects, ostracods, Bacillariophyceae and on grass seeds and decaying plant tissues. Correlation between feeding and food available in the environment was observed. It is adapted to the lacustrine environment though a river form.

Puntius pulchellus and *P. sarana* are marginal submerged vegetative feeders subsisting on *Chara, Hydrilla* and *Vallisneria*. During summer they feed on gastropods by necessity. Feeding habits are correlated with the available food items.

L. fimbriatus with ventrally placed mouth and fimbriated horny lips is highly adapted to bottom browsing. Its stenophagic feeding on sessile diatoms indicates its selectivity in feeding. Irrespective of lotic or lentic environments the fish feeds on similar food.

O. vigorsii is a column feeder preying upon smaller fish and insects. Though euryphagic in habits, it utilises *Spirogyra*, gastropods and incidentlly diatoms, plant matter, ostracods, copepods, etc.

C. catla is selective in feeding upon copepods, followed by diatoms and insects.

Tor spp. feed upon molluscs particularly gastropods followed by insects. There is a close relationship between the food ingested by the fishes and items of food available in the reservoir. Many species take to alternate diet if their basic food is not available due to water level fluctuations and turbidity.

Artificial reservoirs across major Indian rivers are usually deep, steep-sided, devoid of aquatic plants and usually have submerged trees. In the multipurpose Tungabhadra reservoir, water levels fluctuate between 15.24 and 18.29 m, being highest in the post-monsoon and lowest in the summer months. This study was to determine the fish food production and its utilisation by fishes of the 37,814 ha impoundment on the Tungabhadra river. Past observations of food of some fishes of reservoirs deal with *Labeo fimbriatus* and *Puntius kolus* (Chacko and Kurian 1948; Chacko 1951; and Bhatnagar 1963). Recently David *et al.* (1969) have made certain observations on the available forage food of catfishes and several commercial carps in the Tungabhadra reservoir.

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Account of the feeding habits of *Puntius kolus* by Bhatnagar (1963) relates to samples mainly obtained from one or two isolated spots of this reservoir. This paper presents the gut contents of *Puntius kolus* (Sykes), *Puntius pulchellus* (Day), *P. sarana* (Hamilton), *Tor* spp. (Sykes), *Labeo fimbriatus* (Bloch), *L. calbasu* (*Hamilton*), *Catla catla* (Hamilton), *Osteobrama vigorsii* (Sykes) and *Notopterus notopterus* (Pallas) and their correlation with the plankton and biota.

Materials and Methods

The guts were obtained from the experimental gill net catches at fortnightly intervals from seven centres for two years from January 1964 to December 1965, e.g. Nowli/Mudalighatti (Riverine Zone), Sovinahalli and Hampasagar (Transition Zone), Tambrahalli and Katarki (Shallow Zone) and Karkihalli and Vyasankere (Deep Zone) as classified in the work by David *et al.* (1969). The catches were from 30, 40, 45 and 50 mm mesh bar gill nets and 'alivi' shore-seines. After noting the length and weight of each fish, the gut preserved in 5 per cent formalin was analysed. Intensity of feeding based on the state of distension of the guts was expressed as full, three-fourth full, half full, quarter full and empty.

In evaluating the different food organisms, the occurrence method of Hynes (1950) was followed . The contents from pre-, mid-, and hind-guts diluted in known volume of water, were identified. Decayed and semidecayed organic matter, sand or mud were assessed by "eye estimation method". Tables I to V show the pooled monthly fluctuations of the food constituents for two years (see David *et al.* 1969).

Food and Feeding Habits

Puntius kolus (Sykes)

Among 921 gut specimens of 156 to 496 mm (total length), 303 guts were empty.

Bacillariophyceae—Diatoms were fed to an average of 3.5 per cent (Table I) and were represented by *Navicula, Amphora, Pleurosigma, Diatoma, Synedra, Fragilaria, Surirella, Cocconema, Gomphonema* and *Cymbella.*

Chlorophyceae—Chlorophyceae was dominated by *Spirogyra* though *Zygnema, Oedogonium, Mougeotia* and *Cosmarium* were recorded occasionally.

Plant matter—This included decaying aquatic plants and grass blades. Grass seeds encountered during post-monsoon months fully constituted the guts in September (40.2 per cent) and October (36.7 per cent).

Copepods—Appendages and crushed forms represented by *Cyclops, Diaptomus* and various Nauplii stages showed low values in summer months.

Ostracods-Cypris spp. were recorded in all months. Ostracods however occur in insignificant numbers in plankton.

Insects—Insects contributed by chironomids were of the order of 4.2 per cent (September) and 17.6 per cent (February). Mayfly nymphs, appendages and exoskeletal parts of corixid bugs and trichopteran larvae were also noticed.

Gastropods and bivalves— Gastropods formed the heavier food item both in crushed and whole conditions. Small sized *Vivipara, Melanoides* and *Gyralus*

TABLE I

Composition of food constituents (%) in the gut of Puntius kolus

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total	Average Percentage*
No. of guts examined	49	63	177	127	48	—	64	73	76	96	75	73	921	
No. of empty guts	8	22	94	58	20	—	7	20	10	29	10	26	303	
Bacillariophyceae	6.8	7.8	2.4	2.8	0.1	—	2.2	2.1	1.0	1.6	1.4	4.9	—	3.5
Chlorophyceae	0.4	0.2	0.2	—	—	—	—	—	—	0.4	—	—	—	0.1
Plant Matter	4.3	21.2	1.6	—	—	—	—	12.5	40.2	36.7	30.8	13.1	—	**14.5**
Ostracods	6.7	8.5	5.1	4.5	2.6	—	2.2	0.9	8.9	6.4	4.8	4.1	—	4.4
Copepods	4 8	0 6	0 2	0 5	0 7	—	—	2.4	1 8	—	—	—	—	1.0
Insect Matter	16.7	17.6	12.0	16.0	7.8	—	36.7	1.6	4.2	6.9	12.1	16.2	—	**13.4**
Gastropods	5.6	6.3	9.5	15.2	26 5	—	2.9	26.6	4.2	2.6	2.1	5.6	—	9.7
Bivalves	12.3	7.5	36.4	26.1	4.5	—	12.2	—	—	0.3	1.9	3.0	—	9.4
Decayed Organic Matter	33.2	24.4	23.4	24.3	25.6	—	21.5	39.2	37.0	28.5	30.4	36.0	—	**29.2**
Sand and Mud	8.0	5.2	7.6	8.8	29.6	—	21.5	13.9	1.6	15.2	15.4	13.7	—	12.7
Miscellaneous	1.2	0.7	1.6	2.7	2.6	—	0.8	0.8	1.1	1.4	1.1	3.4	—	1.6

*Dominant items are given in bold types

spp., ranging in size from 2 to 6 mm across, were recognised. Bivalves were represented mainly by *Corbicula* and *Unio* spp.

Decayed organic matter and mud— Various animal and plant tissues in semidecayed state were encountered throughout the year. The fish also consumed large quantities of sand and mud unwittingly while sucking the bottom layers.

Miscellaneous— Oscillatoria, Anabaena, Merismopedia, Microcystis, Pediastrum, Scenedesmus, Closterium, Staurastrum, Cosmarium, Ostracodan eggs, cladoceran and annelidan setae were also noticed in a few guts.

Puntius pulchellus (Day)

This is the second dominant major crop of the reservoir. Guts from 123 specimens ranging in size from 250 to 745 mm were examined.

Bacillariophyceae formed one of the minor food items. They were recorded generally during July and September and were absent in May. The epiphytic diatoms are associated with submerged marginal vegetation. *Spirogyra* and other filamentous algae with *Cosmarium,* formed minor food items from January to March.

The fish being mainly herbivorous, ingested high percentage of vascular plants like *Chara, Vallisneria, Hydrilla, Ceratophyllum* spp. (Table II). *Chara* was the predominant food varying from 18.8 to 66.2 per cent but was not recorded in January. *Vallisneria* formed 35 per cent in April and 12.5 per cent in January and November. *Hydrilla* absent during May, July, August and December was recorded in January (35 per cent), February (22.7 per cent), March (16.2 per cent) and November (9.2 per cent). The decayed tissues of higher aquatic plants as well as grass blades, showed high percentages during post monsoon months of August (62.5 per cent), September (30 per cent) and October (45.6 per cent) and lower percentages in other months.

Paramaecium spp. were encountered in all months except in January and May. Higher percentages of gastropods (*Vivipara* and *Pila* spp.) were noted in low water levels in April (21 per cent) and May (45 per cent).

The food items like *Merismopedia* cysts and spores, insect appendages and other unidentifiable items were also noticed in negligible percentages. *Insects as an item of food were almost entirely absent in the fish.*

Puntius sarana (Hamilton)

Guts from 244 specimens were examined of which 180 were empty. This species feeds on a variety of aquatic plants like *Chara, Hydrilla, Vallisneria* and Bacillariophyceae and Chlorophyceae (Table III).

Vallisneria ranged from 4.8 per cent in October to 16.3 per cent in November. *Chara* was the predominant plant ingested upto 20.3 per cent (Table III). *Hydrilla* was maximum in January (22.5 per cent) and minimum in October.

Ostracods were recorded in February, March and October as an incidental food.

Dismembered appendages in insects were recorded in February, April, October and November.

TABLE II

Composition of food constituents (%) in the gut of Puntius pulchellus

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Average Percentage*
No. of guts examined	2	22	31	22	6	—	16	4	11	2	2	5	123	
No. of empty guts	—	—	1	—	—	—	—	—	—	—	—	—	1	
Bacillariophyceae	7.5	7.0	4.6	1.0	—	—	11.5	—	16.2	4.4	9.2	8.8	—	6.4
Chlorophyceae	27.5	8.2	5.1	1.0	—	—	1.7	—	2.5	1.9	0.8	0.8	—	4.6
Vallisneria	12.5	8.5	10.4	35.0	—	—	6	5.0	—	4.4	12.5	0.8	—	**8.1**
Chara	—	36.3	40.8	19.0	40.8	—	66.2	20.0	35.0	18.8	45.1	64.2	—	**35.1**
Hydrilla	35.0	22.7	16.2	1.0	—	—	—	—	7.5	8.1	9.2	—	—	**9.1**
Plant Tissue	—	4.0	4.6	2.0	5.0	—	9.4	62.5	30.0	45.6	13.4	5.0	—	**16.5**
Ciliates	—	4.8	6.6	2.0	—	—	0.9	2.5	3.8	2.7	0.8	4.2	—	2.6
Gastropods	5.0	1.3	3.8	21.0	45.0	—	—	—	—	—	—	0.8	—	7.0
Decayed Organic Matter	10.0	6.1	7.8	16.0	4.2	—	10.0	10.0	5.0	14.1	7.9	15.4	—	**9.7**
Miscellaneous	2.5	1.1	0.1	2.0	5.0	—	0.3	—	—	—	1.1	—	—	1.0

*Dominant items are given in bold type

TABLE III

Composition of food constituents (%) in the gut of Puntius sarana

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Average Percentage*
No. of guts examined	14	22	66	47	5	—	—	3	1	41	24	21	244	
No. of empty guts	8	14	61	41	3	—	—	—	—	22	15	16	180	
Bacillariophyceae	3.1	5.5	3.8	1.2	—	—	—	—	10.0	2.1	9.6	—	—	3.5
Chlorophyceae	15.0	—	—	—	6	—	—	5.0	—	2.6	—	1.0	—	2.3
Vallisperia	—	11.3	—	11.3	—	—	—	—	—	4.8	16.3	10.0	—	5.4
Chara	33.1	9.1	20.0	—	—	—	—	52.5	50.0	—	—	38.0	—	**20.3**
Hydrilla	22.5	6.0	2.5	3.1	—	—	—	—	—	1.3	12.3	10.0	—	5.8
Plant tissue	12.5	1.0	12.5	—	—	—	—	20.0	20.0	21.6	24.3	24.0	—	**13.6**
Ostracods	—	1.3	11.2	—	—	—	—	—	—	4.2	—	—	—	1.7
Insects	—	4.1	—	5.7	—	—	—	—	—	1.0	10.0	—	—	2.1
Gastropods	—	37.8	11.7	35.0	85.0	—	—	5.0	—	11.3	2.5	—	—	**18.8**
Decayed Organic Matter	13.8	22.9	35.0	23.7	10.0	—	—	17.5	20.0	38.4	23.0	17.0	—	**22.1**
Mud	—	1.0	3.3	20.0	5.0	—	—	—	—	12.7	2.0	—	—	4.4

*Dominant items are given in bold type

Decayed organic matter ranged from 10 per cent in May to 38.4 per cent in October.

Particles of sand and mud would have been consumed along with sessile bottom dwelling molluscs. This ranged from 1 per cent in February to 20 per cent in April.

Tor species (Sykes)

Both *Tor khudree* and *Tor mussullah* occurred occasionally in the commercial catches; only eight specimens of sizes 275–870 mm were examined.

Both species appear to feed on the bottom and column subsisting on gastropods, bivalves, insects, decayed organic matter and detritus.

Labeo fimbriatus (Bloch)

Guts of 190 specimens ranging in sizes from 203 to 636 mm were examined and of which 83 guts were empty.

Plankton exclusively formed the basic items of diet of this browsing fish. Table IV presents the monthly fluctuations in the food constituents.

Myxophyceae—Very low quantities of *Oscillatoria, Anabaena* and *Microcystis* were encountered in all months except in January and July.

Bacillariophyceae—This group was the dominant basic food except in May–July, forming 50 per cent in October and 0.4 per cent in May.

Chlorophyceae—The second major basic food item represented by *Spirogyra, Mougeotia* and *Hormidium* ranged from 1.6 per cent in August to 11.2 per cent in April, being absent in the months of May–July.

Plant tissue was noticed rarely.

Copepods—Copepods to an extent of 0.4 per cent to 3.1 per cent were found in some months only.

Various appendages of insects (mainly of chironomids) were encountered.

Decayed organic matter—The largest food item was contributed by semidecayed and decayed matter forming 37.5 per cent of the average food. It occurred in all the months, lowest being in October (12.5 per cent) and highest in June (70 per cent).

Sand and mud frequently occurred to an average of 26.8 per cent of the feed.

The miscellaneous items like lower crustacean eggs, annelidan setae and other unidentifiable forms were noticed throughout the year.

Labco calbasu (Hamilton)

Only 27 specimens of size range, 211 to 492 mm were examined of which 12 guts were empty.

This fish being a bottom feeder, closely resembles *L. fimbriatus* in its food habits. Bacillariophyceae (18.7 per cent) constituted the main food while Chlorophyceae with 4.4 per cent (*Spirogyra, Merismopedia, Cosmarium*) ranked next. Insect appendages (mostly chironomids) and plant tissue were occasionally observed in the guts in small quantities. Miscellaneous items like annelidan setae, fungi, *Oscillatoria,* protozoan ciliates (particularly *Paramecium* spp.) were also recorded along with decayed organic matter and mud.

TABLE IV

Composition of food constituents (%) in the gut of Labeo fimbriatus

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Average percentage*
No. of guts examined	8	12	54	25	15	3	4	18	12	3	20	16	190	
No. of empty guts	1	6	27	15	3	2	2	7	2	1	7	10	83	
Myxophyceae	—	1.6	0.5	5.6	3.7	5.0	—	0.4	1.5	2.5	1.2	3.4	—	2.1
Bacillariophyceae	30.6	38.4	19.0	16.6	0.4	—	2.5	24.6	17.8	50.0	38.8	28.4	—	**22.3**
Chlorophyceae	5.6	9.2	8.3	11.2	—	—	—	1.6	2.5	2.5	4.2	5.8	—	4.2
Plant matter	3.8	3.3	—	—	—	—	—	4.0	1.2	—	6.8	7.4	—	2.2
Copepods	0.6	—	—	0.6	0.4	—	—	—	3.1	—	—	1.7	—	0.5
Insect matter	6.8	—	—	1.2	—	—	2.5	—	—	5.0	—	—	—	1.3
Animal matter	3.3	2.5	1.5	—	—	—	—	—	—	—	—	—	—	0.6
Decayed organic matter	32.2	20.9	39.5	30.4	59.1	70.0	65.0	33.0	35.7	12.5	29.4	21.8	—	**37.5**
Sand and Mud	13.8	20.0	28.5	31.6	36.4	25.0	25.0	35.4	36.6	25.0	18.5	25.8	—	26.8
Miscellaneous	3.3	4.1	2.32	2.8	—	—	5.0	1.0	1.6	2.5	1.1	5.7	—	2.5

*Dominant items are given in bold type

Catla catla (Hamilton)

Catla catla stocked in the reservoir appeared in stray numbers in commercial catches. Of the 20 specimens (231 to 975 mm) examined, three showed empty guts.

C. catla is a stenophagic feeder on several food organisms, though generally considered a column feeder.

Bacillariophyceae—Represented by *Navicula, Amphora, Pleurosigma, Synedra* and *Diatoma,* contributed to only 4.4 per cent of average feed.

Copepods—Represented by Nauplii, copepodite stages and adults of *Cyclops* and *Diaptomus* formed the bulk item of the food up to 57.3 per cent on an average.

Insects—Chironomid larvae and other insect appendages were observed in a few guts only to an extent of 1.2 per cent of average feed.

Digested organic matter accounted for 25.9 per cent of gut contents. It was present in all the guts and was mainly of planktonic origin. Miscellaneous items and mud contents together contributed to 11.2 per cent of the average feed.

Osteobrama vigorsii (Sykes)

Osteobrama vigorsii is one of the dominant, medium sized (103–349 mm) species. Among 452 guts examined, 244 were empty.

Table V shows the monthly fluctuations in the food constituents.

Filamentous algae represented by *Spirogyra* were consumed during May, June and September . Plant matter was ecountered to an extent of 1.6 to 10.9 per cent during post-monsoon.

Crustacea represented by copepods and ostracods (entomostracans) contributed to 1.2 per cent of the average feed .

Insects—Insects however formed the second important basic food of the fish. While their percentages varied from 0.80 in March to a maximum of 53.90 in June, they were not recorded in January and April.

Gastropods—Gastropods ranged from 1 to 5 per cent and were found in March and August to October. (Mud encountered in post-monsoon months had entered along with gastropods as an incidental item).

Fish-remains—Fish-remains accounting for 50.8 per cent on an average, formed the dominant food of *O. vigorsii.* In all months except in June, fish-remains were encountered consistently, ranging from 17.2 per cent in September to 96.8 per cent in April.

Animal and decayed organic matter—Unidentifiable animal matter, was present in some months, decayed organic matter was recorded with the lowest percentage in April and highest in August.

Notopterus notopterus (Pallas)

N. notopterus contributed very little to the commercial fishery catches. Stomachs from 86 specimens with sizes ranging from 230 to 354 mm in length were examined. Among them 19 stomachs were empty. A variety of food organisms like insects, fishes, prawns, and plant matter was encountered.

Prawns—Prawns (*Leander* spp.) often recorded ranged from 15.6 to 28.6 per cent.

TABLE V

Composition of food constituents in the gut of Ostreobrama vigorsii

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total	Average percentage*
No. of guts examined	43	45	104	40	60	16	5	17	29	19	36	38	452	
No. of empty guts	28	25	69	27	29	7	2	5	4	8	15	25	244	
Chlorophyceae	—	—	0.9	—	10.8	25.0	—	—	7.3	—	—	—	—	3.7
Plant matter	—	—	—	—	—	—	—	8.0	10.9	6.5	1.6	—	—	2.3
Crustacea	—	3.2	5.8	—	—	—	—	—	4.5	1.5	—	—	—	1.2
Insects	—	6.0	0.8	—	38.5	53.9	16.0	15.0	1.5	1.1	11.9	14.8	—	**12.5**
Gastropods	—	—	1.4	—	—	—	—	5.0	3.6	1.0	—	—	—	0.9
Fish remains	69.3	73.8	76.8	96.8	43.5	—	40.0	27.0	17.2	48.6	44.7	72.7	—	**50.8**
Animal matter	18.4	10.3	2.6	2.0	—	—	20.0	—	12.2	12.4	11.8	—	—	7.5
Decayed organic matter	12.3	6.0	11.2	1.2	17.2	21.1	24.0	39.5	32.5	24.7	25.6	12.5	—	**19.0**
Mud	—	0.5	—	—	—	—	—	5.5	3.5	4.2	4.2	—	—	1.5
Miscellaneous	—	0.2	0.5	—	—	—	—	—	6.8	—	0.2	—	—	0 6

*Dominant items are given in bold type

Insects—Mostly dragon-fly nymphs were present throughout the year except in September. The percentage of insects varied from 1.2 to 74.4 per cent of the monthly feed.

Fish—Fish remains were encountered in January, March and April (22.5 to 55.8 per cent). In a few cases fingerling sized *Glassogobius giuris* were found in the stomachs. Obviously sluggish fish and prawn were preyed upon by *N. notopterus.*

Decayed organic matter—Decayed organic matter was present in all the months with the maximum in October and minimum in November.

Sand and mud—Sand and mud together constituting 4.7 per cent of the total feed were encountered in February, April, August and December.

Miscellaneous—Apart from the above items, miscellaneous food like Bacillariophyceae, Chlorophyceae, ostracods and gastropods together contributed to 1.3 per cent of the average feed.

Correlation of Bottom Biota and Plankton with Feeding

Seshappa and Bhimachar (1955) related the occurrence of the Malabar sole — *Cyanoglossus semifasciatus* (Day) with the bottom fauna and showed that its fishery is dependent on peaks in bottom fauna of the area. Bhimachar and George (1952) had observed earlier close similarity between food constituents of the Mackerel— *Rastrelliger kanagurta* and planktonic elements during different seasons of the year. Such studies have not been made for fishes in the Indian rivers or estuaries though some stray records are available for fishes in polluted stretches of rivers (David 1956; David and Ray 1966 and Ray and David 1966).

Littoral and bottom biota

Bottom biota constitutes an important link in the food chain of fishes in inland water sheets, particularly in tanks and reservoirs where their distribution and growth are functions of environmental conditions.

The bottom macrofauna pooled for all zones showed distinct peaks in January, April, September and December 1964 and May and September 1965.

Of the two items of food, molluscs (gastropods) — 76.4 per cent and insects — 20 per cent (by numbers) available in the bottom biota in January 1964 (David *et al.* 1969), *P. kolus* utilised insects far better than molluscs. Similarly in April 1964 biota consisted mainly of insects (57.3 per cent), chiefly contributed by chironomids (20 per cent). In September 1964 while the bottom showed an insect predominance of 53.7 per cent for the whole reservoir, utilisation was only to an extent of 4.2 per cent of the total feed of *P. kolus* in that month.

In May 1965, gastropodan molluscs (86.0 per cent) dominated over insects (8.0 per cent) in the bottom biota. These were present as food in *P. kolus,* constituting 31.0 and 7.8 per cent of the food. In September 1965, gastropods predominated (72.7 per cent) and insects were low (15.5 per cent) in the biota and food ingested showed a low utilisation of both molluscs and insects.

During April and May 1965, gastropods were predominant. Food of *P. pulchellus* in deep zone showed in April mostly small gastropods while their availability was 87.0 per cent; insects and worms were not utilised at all by *P. pulchellus.* As it is

exclusively a vascular plant feeder (David and Rahman 1972), *Vallisneria, Chara* and *Hydrilla* that dominated in the region of capture formed its main food. Some diatoms which were epiphytic on these submerged vegetation formed an incidental food of the fish and small gastropods formed obligatory food during low water levels.

L. fimbriatus is a selective bottom feeder subsisting mostly upon sessile, epiphytic diatoms. The order of abundance in occurrence of some biotal organisms was not the same in the corresponding analyses of gut contents. Among the bottom biotal elements, the fish consumed chironomids meagrely, though they were available adequately. Thus feeding on chironomids may be considered as only incidental.

Plankton

Among plantkonic items of ingested food in *P. kolus*, the order was diatoms, ostracods, copepods and Chlorophyceae when the order of dominance in plankton during 1964 was copepods and diatoms. Diatoms (pooled) which were 20.9 per cent of the total plankton in 1964 formed 4.6 per cent of the feed of *P. kolus;* copepods and Chlorophyceae which formed 21.4 and 10.3 per cent respectively, were found only to an extent of 2.5 and 0.6 per cent of the feed. Similarly in 1965, diatoms and copepods (10.5 and 7.5 per cent of the total plankton) were found to an extent of 2.1 and 2.2 per cent of the feed. As plankton revealed varying groups and densities, the feed of *P. kolus* reflected similar trends, but the fish is not a major plankton consumer.

Diatoms were 1.2 and 10.0 per cent of the total feed during April and September 1965 in *P. sarana* while the concentrations were 31.0 and 45.1 per cent in the plankton In December 1964, Chlorophyceae formed 78.5 per cent of the plankton but was present only to the extent of 15. 0 per cent of its feed. *P. pulchellus* being a vascular plant feeder, did not show significant correlation with plankton availability. In the riverine zone, Chlorophyceae, diatoms and Myxophyceae were utilised to an extent of 20, 20 and 5 per cent resepectively by *Labeo fimbriatus* when their densities were 65.8, 24.4 and 9.8 per cent. Similar trends were noticed in the transitional zone indicating that the fish avoided Myxophyceae utilising it only up to 2.5 per cent when its population was once as high as 82.3 per cent. In January 1964 when diatoms were 79.3 per cent in plankton in the shallower zone, its amount in the gut was 50 per cent of the total feed. In the deep zone as well, the same trends were noted, the fish feeding on diatoms, unicellular algae and zooplankton. This indicates that the fish is mainly a browser. The abundance of Bacillariophyceae within the guts between October and February concurs with its availability in plankton as well as upon water weeds. Nonavailability of Chlorophyceae during monsoon and the low concentrations during post-monsoon were also reflected in the guts.

Discussion

The Tungabhadra reservoir yielded *P. kolus* to the maximum commercial level during 1963, 1964 and 1965 (David *et al.* 1969, p. 100). The reservoir offers one or the other type of food to the fishes at several water levels (David *et al.* 1969). During rainy season, the submerged vegetation offers masses of decaying food to the fishes. Grasses and their seeds are also consumed by some of them. Terrestrial insects

formed an important item of food of several fishes. The frequent occurrence of ostracods as an item of food in *P. kolus* indicates that atleast for feeding, the fish browses on the gradually sloping shallower margins of the reservoir (David *et al.*1969).

With its ventrally placed mouth and fimbriated horny lips *L. fimbriatus* seems to be highly adapted to bottom browsing. Its stenophagic nature of feeding on a few types of food items particularly sessile diatoms, indicates its selectivity. Irrespective of lotic or lentic environments the fish is observed to feed on almost similar items of food. (Chacko and Kurian 1948 Bhatnagar 1963 and Bhatnagar and Karamchandani 1970) and is also adapted to live in reservoirs.

Though *O. vigorsii* is euryphagic in its dietary habits, it can utilise available food items like *Spirogyra*, gastropods and incidentally also diatoms, plant matter and ostracods or copepods besides fishes and insects. The large quantity of insect food in this fish from May to July was accountable to the fact that the guts were obtained from specimens in the riverine zone at the tail-end of the reservoir. This period coincided with abundance of insects drifting into the reservoir in the fluvitile conditions prevailing at the time (David *et al.* 1969).

C. catla is selective in its feeding upon planktonic copepods, followed by diatoms and insects. *Tor* spp. feed upon a molluscs diet particularly gastropods followed by insects.

The food of *P. pulchellus* and *P. sarana*, varies with fluctuating water levels in the reservoir. Thus the fishes had fed on gastropods in the deepest Vyasankere area which was rich in gastropods without any littoral vegetation and on available vegetation in shallow areas.

Where riverine to lacustrine conditions were gradual, insects, worms and epiphytic plankton (including diatoms on mud surface) were rich. These were utilized by the fishes as food.

It is also significant that in Katarki bay with uniformly deposited silt by a stream, chironomid larvae and a short seasonal growth of *Chara* were found to be very rich (David *et al.* 1969). In Karkihalli area the margin was sandy with the deeper areas silted, the former supporting molluscs and the latter chironomids with moderate amounts of aquatic weeds. The species of fish that were found in these areas were mainly *Puntius kolus, P. pulchellus* and *P. sarana.*

In estuarine environment, Pillay (1953) observed that the adults of *Mugil tade* feed on decayed organic matter and live plants within the "illiotrophic layer"*. Similarly in the present investigations, the epiphytic diatoms forming food of *L. fimbriatus* were being closely associated with or upon the algal complex found in the gradual sloping margins of the transition zone of upto a depth of half a meter.

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*The layer of minute benthic plant and animal life together with dead and decayed organic matter on the muddy bottom of water areas.

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